OCS Report
MMS 2001-086

Atlas of Gulf of Mexico Gas and Oil Sands

as of January 1, 1999

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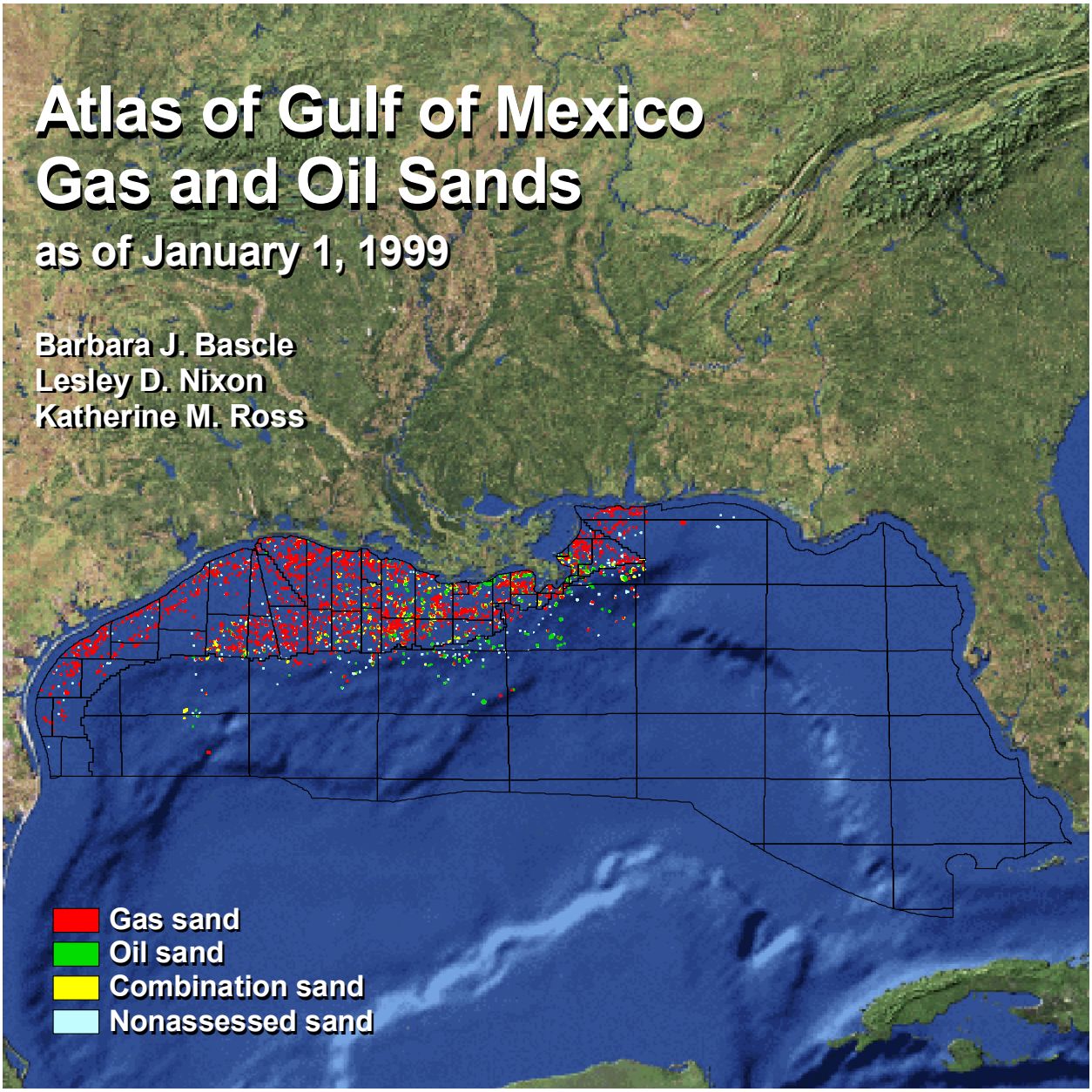

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Regional Office
Office of Resource Evaluation

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Summary

This report presents an update of the *Atlas of Northern Gulf of Mexico Gas and Oil Reservoirs, Volume 1 — Miocene and Older Reservoirs* (Seni et al., 1997) and *Volume 2 — Pliocene and Pleistocene Reservoirs* (Hentz et al., 1997) for the Federal Offshore Continental Shelf (OCS). The OCS comprises the portion of the seabed of the United States whose mineral estate is subject to Federal jurisdiction. This update considered data and information available as of January 1, 1999.

The petroleum commodities reported in this study are crude oil, natural gas liquids (condensate), and natural gas that exist in conventional reservoirs and are producible with conventional recovery techniques. The volumetric estimates of oil, reported as stock tank barrels, represent combined volumes of crude oil and condensate; the volumetric estimates of gas, reported in standard cubic feet, represent combined volumes of associated and nonassociated gas. The combined volume of oil and oil-equivalent gas (i.e., 5,620 cubic feet of gas per barrel of oil) is referred to as combined oil-equivalent reserves or BOE (barrels of oil equivalent) and is reported in barrels.

Results

For this study, the Federal offshore Gulf of Mexico (GOM) Region comprises 65 established plays, 18 chronozones, 6 series, 4 systems, and 2 provinces. The allocation of proved and unproved reserves, cumulative production, and remaining proved reserves at each of these levels is shown in the Summary Tables.

Total

The GOM Region contains 10,235 sands in 1,042 fields with reserve estimates. The hydrocarbons in these sands are 66% gas and 34% oil. The total amount of reserves (proved plus unproved) is calculated to be 167,813.071 Bcfg and 15,261.283 MMbo (45,121.260 MMBOE). Cumulative production from the GOM Region totals 132,676.625 Bcfg and 10,907.550 MMbo (34,515.490 MMBOE) from 9,470 sands in 962 fields (Table 1).

Categorizing these reserves, proved reserves are estimated at 162,711.094 Bcfg and 14,265.880 MMbo (43,218.032 MMBOE) in 10,035 sands in 984 fields, and unproved reserves are estimated at 5,101.976 Bcfg and 995.403 MMbo (1,903.228 MMBOE) in 200 sands in 58 fields. Remaining proved reserves are 30,034.469 Bcfg and 3,358.330 MMbo (8,702.542 MMBOE) in 5,634 sands in 776 fields.

	No. of Sands	Oil (MMbbl)	Gas (Bcf)	BOE (MMbbl)
Proved	10,035	14,265.880	162,711.094	43,218.032
Cum. production	9,470	10,907.550	132,676.625	34,515.490
Remaining proved	5,634	3,358.330	30,034.469	8,702.542
Unproved	200	995.403	5,101.976	1,903.228

Table 1. GOM reserves and cumulative production.

Depositional Style/Facies

Reserves across the GOM are unevenly distributed in terms of depositional style/facies (Figure 1, Table 2). Historically, progradational sands have been the most prolific producers of oil and gas. In fact, 55% of the oil reserves (8,410.585 MMbbl) and 65% of the gas reserves (108,105.350 Bcf) occur in progradational sands. Moreover, on the basis of BOE amounts, 8 of the largest 10 plays in the GOM are progradational (Figure 2). The progradational depositional style results in favorable associations of reservoir, source, and seal and is characterized by alternating reservoir-quality sands and thick sealing shales. In addition, progradational deposits coincide with areas having large growth faults, rollover anticlines, and diapiric salt. All of these factors contribute to the high productivity of these sediments (Seni et al., 1994).

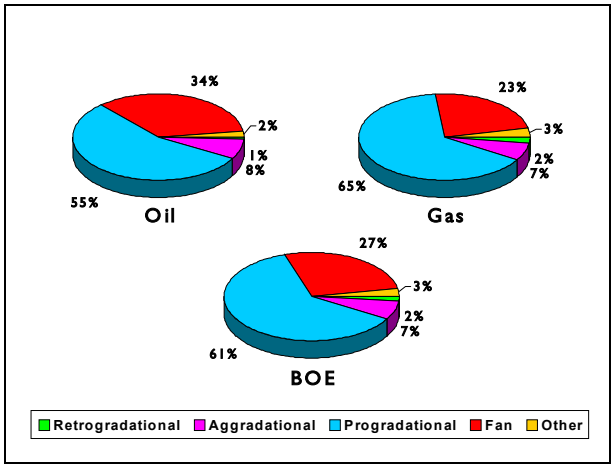

Figure 1. GOM proved and unproved reserves by depositional style/facies.

Proved & Unproved Reserves (Summation of individual values may differ from total values due to rounding)	Oil (MMbbl)	Gas (Bcf)	BOE (MMbbl)
Retrogradational	109.987	3,664.935	762.111
Aggradational	1,151.669	11,231.734	3,150.198
Progradational	8,410.585	108,105.350	27,646.412
Fan	5,236.873	39,100.985	12,194.344
Other	352.169	5,710.067	1,368.195
Region Total	**15,261.283**	**167,813.071**	**45,121.260**

Table 2. GOM proved and unproved reserves by depositional style/facies.

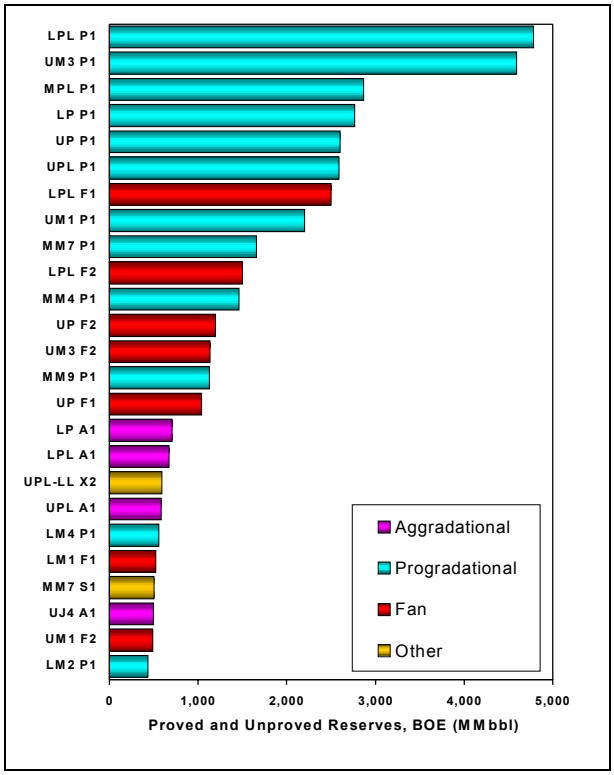

Figure 2. 25 largest GOM plays, ranked by proved plus unproved reserves.

Fan deposits rank next in reserve estimates, containing 34% of the oil reserves (5,236.873 MMbbl) and 23% of the gas reserves (39,100.985 Bcf). Reflecting an increasing importance in the reserves base, the fan deposits contain the largest amounts of unproved reserves, with 2,789.133 Bcf and 692.940 MMbbl (1,189.227 MMBOE).

Aggradational deposits contain 8% of the oil reserves (1,151.669 MMbbl) and 7% of the gas reserves (11,231.734 Bcf), while retrogradational deposits contain 1% of the oil reserves (109.987 MMbbl) and 2% of the gas reserves (3,664.935 Bcf). The remaining 2% of the oil reserves (352.169 MMbbl) and 3% of the gas reserves (5,710.067 Bcf) are within plays that (1) contain more than one depositional style (e.g., UM3 AP1, UM1 AP1, and MM9 AP1), (2) are defined structurally (e.g., the Corsair Fault Trend and the deepwater Fold Belts), or (3) are carbonates (e.g., James Limestone and Andrew Formation).

Geologic Age

Reserves in the GOM are unevenly distributed in terms of geologic age as well (Figure 3, Table 3). Reserves have been discovered in GOM sediments ranging in age from upper Jurassic to upper Pleistocene. Miocene age sediments, with 70,895.396 Bcfg and 5,275.127 MMbo (17,889.967 MMBOE) and Pleistocene age sediments, with 65,896.088 Bcfg and 5,246.280 MMbo (16,971.563 MMBOE), have proven to be the most prolific to date, each containing approximately 40% of the GOM Region's reserves. Pliocene age deposits, with 26,465.470 Bcfg and 4,437.509 MMbo (9,146.667 MMBOE), contain approximately 20% of the Region's reserves. The most significant amount of hydrocarbons present in Mesozoic sediments is gas trapped in the eolian dunes of the Norphlet Formation in the northeastern GOM.

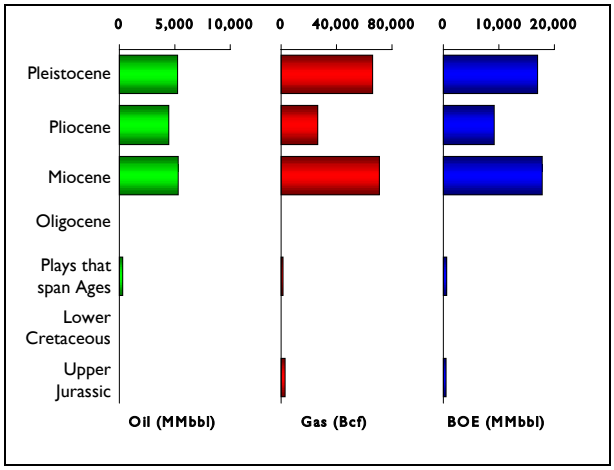

Figure 3. GOM proved and unproved reserves by geologic age.

Proved & Unproved Reserves (Summation of individual values may differ from total values due to rounding)	Oil (MMbbl)	Gas (Bcf)	BOE (MMbbl)
Pleistocene	5,246.280	65,896.088	16,971.563
Pliocene	4,437.509	26,465.470	9,146.667
Miocene	5,275.127	70,895.396	17,889.967
Oligocene	0.905	43.768	8.693
Plays that span Systems	301.184	1,633.454	591.834
Lower Cretaceous	0.070	78.201	13.985
Upper Jurassic	0.207	2,800.694	498.551
Region Total	**15,261.283**	**167,813.071**	**45,121.260**

Table 3. GOM proved and unproved reserves by geologic age.

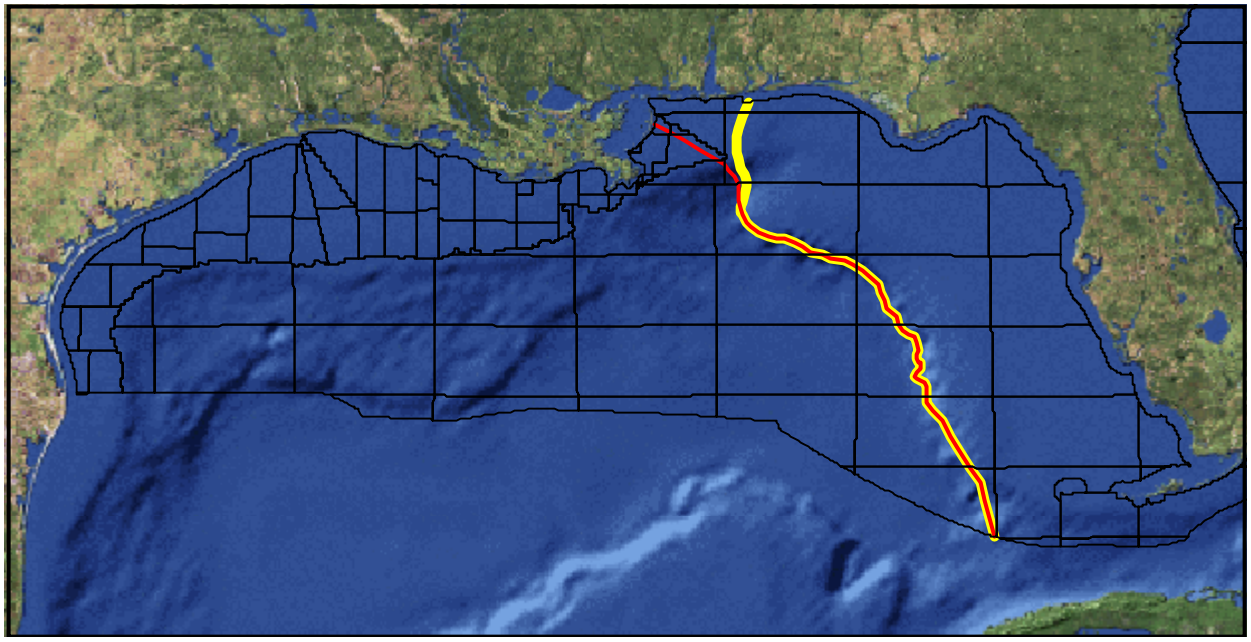

Figure 4. Map of the GOM provinces. The established plays of the Cenozoic Province occur from the gold line westward while the established plays of the Mesozoic Province occur from the red line eastward. Note the area of overlap east of the Mississippi River Delta.

Provinces

In this report, the GOM Region is divided into two provinces—Cenozoic and Mesozoic (Figure 4)—which include 65 plays that contain reserve estimates. Sixty-two of these plays are Cenozoic deltaic deposits and contain most of the reserves in the GOM, with 99% of the total (Figure 5). The eolian dunes of the Norphlet Formation and the reef-system carbonates of the James Limestone and Andrew Formation compose the 3 plays in the Mesozoic Province.

The 62 plays in the Cenozoic Province contain 164,934.176 Bcfg and 15,261.006 MMbo (44,608.724 MMBOE) in 10,213 sands in 1,029 fields. Of these sands, 9,454 in 952 fields have produced 131,946.423 Bcfg and 10,907.415 MMbo (34,385.426 MMBOE). The 3 plays in the Mesozoic Province contain 2,878.894 Bcfg and 0.277 MMbo (512.536 MMBOE) in 22 sands in 18 fields. Sixteen of these sands in 15 fields have produced 730.202 Bcfg and 0.135 MMbo (130.065 MMBOE).

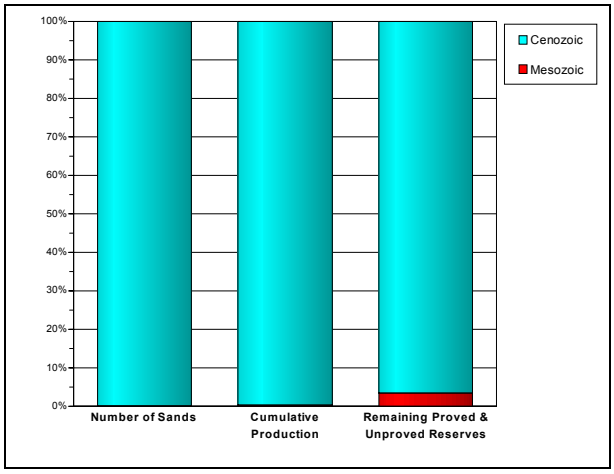

Figure 5. GOM Region province percent graph showing percent by province of number of sands discovered, cumulative production, and remaining proved plus unproved reserves.

Introduction

Energy is the lifeblood of the world's economy. Since displacing coal early in the last century, crude oil has been the world's primary source of energy. The United States is currently experiencing a dramatic increase in the use of natural gas, mainly as the environmentally preferred fuel for the generation of electricity. In 1998, oil and gas resources comprised 63% of the world's total energy consumption, up from 60% in 1994. Worldwide reliance on petroleum resources as the principal fuel to satisfy future energy demand is likely to continue for decades. Since the Gulf of Mexico (GOM) Offshore Continental Shelf (OCS) currently contributes 13 and 25% of the United States' domestic oil and gas production, respectively, it is essential to understand the characteristics and distribution of the oil and gas, establishing a solid basis for decisions related to resource management issues.

Purpose

The *Atlas of Northern Gulf of Mexico Gas and Oil Reservoirs, Volume 1 — Miocene and Older Reservoirs* (Seni et al., 1997) and *Volume 2 — Pliocene and Pleistocene Reservoirs* (Hentz et al., 1997) were first published in 1997 by the Bureau of Economic Geology of the University of Texas at Austin. This major undertaking was funded by the Gas Research Institute, the U.S. Department of Energy, and the U.S. Department of the Interior Minerals Management Service (MMS). The publication incorporated both onshore State data from Texas, Louisiana, Mississippi, and Alabama and Federal OCS data as of January 1, 1995. Additionally, as part of our ongoing mission, it is our goal to provide periodic updates of the extensive reserve and production database, maps, and text that were presented in the aforementioned published volumes.

The objectives of the Atlas project are to

- organize all Federal OCS offshore gas and oil sands in the GOM into plays on the basis of geologic and engineering parameters;
- illustrate and describe each play and typical sands within each play;
- tabulate sands to include descriptive and quantitative summaries of play characteristics, cumulative production, reserves, and various other engineering and geologic data; and
- provide the spatial location of plays, fields, and sands through a computerized geographic information system (GIS) available on CD-ROM (herein referred to as "digital data files").

Since the first Atlas publications, significant new leasing, drilling, and discoveries have occurred in the GOM. This MMS update of the Federal OCS portion of the Atlas incorporates and emphasizes the significant trends that have occurred up to January 1, 1999, thus incorporating data and information, especially significant deepwater discoveries, not available at the time of the previous Atlas publications.

This update uses the same play analysis approach as used for the 1997 Atlas publications and relies primarily upon detailed investigations incorporating relatively abundant subsurface geologic and geophysical data, as well as actual reservoir performance information associated with the particular reservoir. An extensive effort was involved in defining plays, in delineating the geographic limits of each play, and in compiling data on critical geologic and reservoir engineering parameters (Hunt and Burgess, 1995; Seni et al., 1997; Hentz et al., 1997). The results were subsequently aggregated up to the region level.

Reserves and production amounts, maps, text descriptions, engineering parameters, and a series of additional analyses, including discovery and production histories, are presented at each of the following levels: play, chronozone, series, system, province, and region.

Changes

This Atlas update contains several major changes from the first Atlas series published in 1997. This update

- presents only Federal OCS data;
- is totally digital on one CD-ROM;
- is available directly from MMS;
- does not present the large composite type log cross sections more apropos to large, coffee-table-size hardcopies;
- contains plays reflecting the aggregation of numerous subplays (e.g., UM1 P.1A and UM1 P.1B are now simply UM1 P1);
- contains fan plays reflecting the interaction between depositional and structural setting;

- contains maps with both hydrocarbon and play limits that are based on sand outlines, not field outlines;
- contains sands not limited to a minimal reserve estimate cutoff;
- uses UJ as the abbreviation for Upper Jurassic instead of UU; and
- contains Deepwater Gulf of Mexico and Gulf of Mexico Subsalt Play sections.

Companion Publication

A companion publication—*2000 Assessment of Conventionally Recoverable Hydrocarbon Resources of the Gulf of Mexico and Atlantic Outer Continental Shelf – as of January 1, 1999* (Lore et al., 2001)—builds upon the Atlas in several ways, including

- aggregation of sand-level data to the pool level;
- application of an appreciation or growth factor to reserves at the pool level;
- evaluation of conceptual or frontier plays that do not contain reserves;
- estimation of undiscovered resources at the play level; and
- assessment of economically recoverable resources at the play level.

The Atlas provides an extensive geologic, reservoir engineering, and production database. The aforementioned assessment provides reserves growth and undiscovered resource amounts. Together, these two products allow others to use their own techniques in performing a resource assessment or evaluate the economic viability of the postulated resources.